

.....

15400 Calhoun Drive, Suite 400  
Rockville, Maryland, 20855  
(301) 294-5241  
<http://www.i-a-i.com>

# Intelligent Automation Incorporated

## Coherent distributed radar for high-resolution through-wall imaging

### Progress Report 21

**Contract No. N00014-10-C-0277**

*Sponsored by*

Office of Naval Research

COTR/TPOC: Martin Kruger



Prepared by

Eric van Doorn, Ph.D. (PI)

Satya Ponnaluri, Ph.D.

Distribution Statement A: Approved for public release; distribution unlimited.

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>FEB 2012</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2012 to 00-00-2012</b>	
4. TITLE AND SUBTITLE <b>Coherent Distributed Radar For High Resolution Through-Wall Imaging</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Intelligent Automation Incorporated, 15400 Calhoun Drive, Suite 400, Rockville, MD, 20855</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>5</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

# 1 Work performed this reporting period

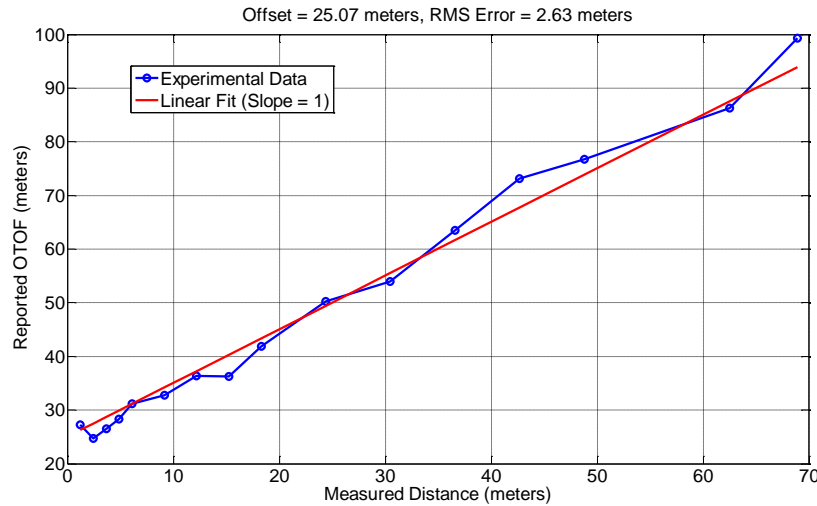
## 1.1 Technical work performed in this reporting period

During this period of performance, we concentrated our efforts in the following technical tasks

- Processed data collected in different node location configurations for accuracy of the currently implemented algorithm
  - Outdoor
  - Indoor (LOS)
  - Indoor (NLOS)

The currently implemented algorithm is an edge detection algorithm. It sets the base line performance of the current ranging system. In the next reporting periods, we will re-process this data to show the improvement achievable by digital beam forming.

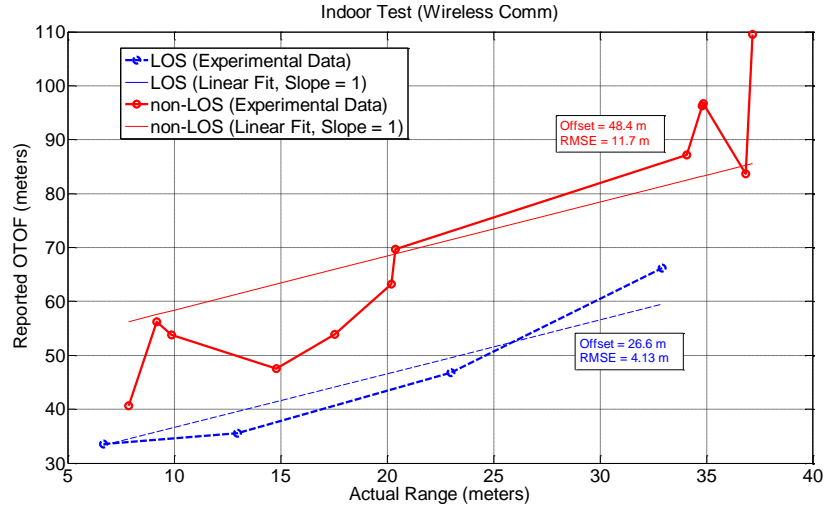
Figure 1 shows the correlation between the actual measured range between the master and the slave and the reported range (One-Time Of Flight, or OTOF) from our system. Our data shows an RMS range error of 2.6 meters for the outdoor case.



**Figure 1. Correlation of measured and reported OTOF data for the outdoor case**

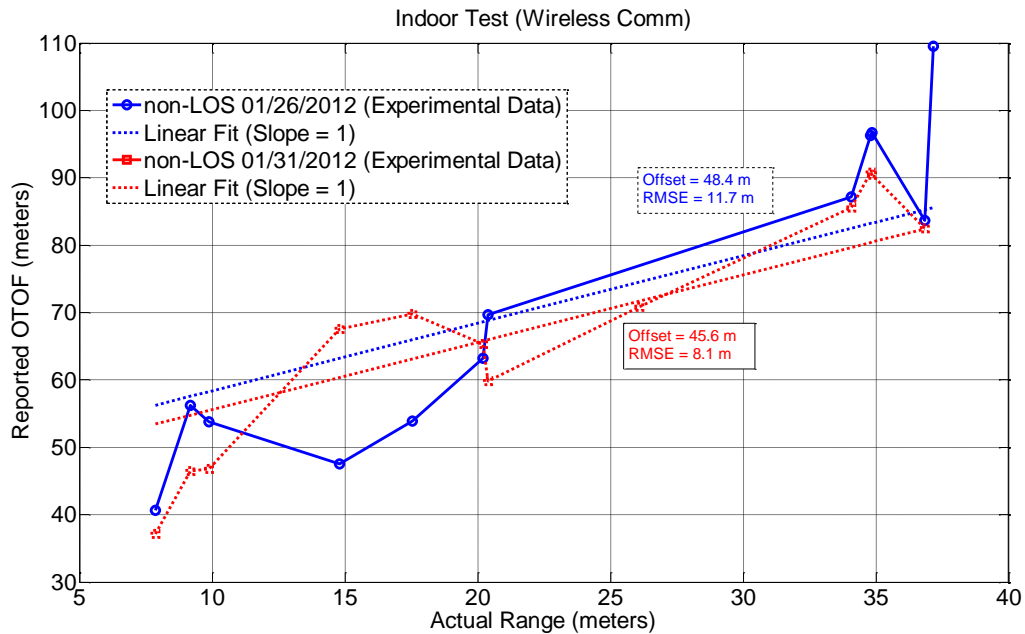
We also processed data collected in two indoor configurations: LOS, and NLOS.

The correlation between the actual range and reported OTOF for these two subsets are shown separately in Figure 2. This plot shows that for the non-LOS case, the range has an RMS error of 11.7 meters.



**Figure 2. Correlation of measured and reported OTOF data for the indoor case**

A second set of data was taken inside the Intelligent Automation building (shown in Figure 3) at similar waypoints. This plot indicates that the system is quite repeatable even for the non-LOS case when the experiment location is the same.



**Figure 3. Comparison of two indoor, non-LOS data sets**

### 1.1.1 Range Accuracy Improvement

Currently we are investigating algorithms to improve the range accuracy of our system. The two algorithms that we are studying are:

- Channel Estimation
- Digital beam forming

In addition to recording the reported OTOF during our previous indoor/outdoor experiments, we have recorded the I and the Q data reported by our system. This data will be used to study these algorithms for bi-static radar imaging, and range accuracy improvement.